A characterization method for defects of zeolite separation membrane by using images obtained from fluorescence confocal optical microscopy (FCOM): based on image processing and 1-D permeation modeling

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Zeolite membranes have come under the spotlight for membrane separation because of their high performance in the separation processes including the separation CO2/N2, p-xylene/o-xylene, etc. However, the separation performance is severely degraded by the existence of defects (cracks and grain-boundaries). In this study, we designed a new characterization method by using images obtained from fluorescence confocal optical microscopy. Herein, the representative quantitative properties (porosity and tortuosity) relevant to the defects were obtained via the image processing. Furthermore, the estimation of the defect sizes was complemented by the use of a one-dimensional permeation model for the molar flux across a membrane. Using this combination, we found that although the amount of defects in the whole zeolite membrane was close to ~ 1%, they provided non-selective, facile pathways that a large amount of the total molar flux.